[2011]

# Fall Injury Report

(2002 – 2009 Iowa State Trauma Registry Data)

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Unintentional falls are the leading cause of non-fatal injuries (adjusted rate of injury 2,653.7 per 100,000 population) and 3<sup>rd</sup> leading cause of unintentional injury-related death (adjusted rate of death 7.0 per 100,000 population) across all ages in the United States (2007).<sup>1</sup> In adults aged 65 and older, falls are the leading cause of non-fatal injury and death. In 2007, unintentional falls was the 2<sup>rd</sup> leading cause of injury-related death in the state of lowa (adjusted rate of death 9.1 per 100,000 population) and the leading cause of death in those aged 65 and older.<sup>1</sup> Unintentional fall-related injuries are also a leading cause of non-fatal injury in lowa.<sup>2</sup>

The literature focuses particularly on falls in the elderly, which is understandable since falls in those aged 65 and older comprise the highest risk group. However, less is known about falls among young children and very little attention has been given to falls among young to middle-age adults. We identified time trends and characteristics of falls by gender, mechanism, and across all ages using a comprehensive statewide trauma database.

# **METHODS**

This study was a retrospective analysis of the Iowa State Trauma Registry (STR), a systematic, prospective, comprehensive statewide trauma dataset. The Iowa Trauma system designates all acute care hospitals as Level I through Level IV (n=117). Data is collected from Level I through Level III hospitals (n=28), including patients that were transferred from other hospitals in Iowa. Inclusion into the trauma registry required that trauma patients seen in a Level I - IV trauma care facility meet one of the following requirements: admission to hospital, transfer to hospital, or a patient that died on arrival or died during evaluation or treatment at hospital. Thus, the STR provides population-based statewide data for all injuries that meet the registry criteria, regardless of the hospital of admission. The Trauma System Coordinator from the Iowa Department of Public Health aggregated the data from each hospital using State Trauma Registry (STR) software, COLLECTOR (Copyright 2001, State Trauma Registry, Digital Innovations, Inc.).

We obtained data on 31,627 patients treated between January 1, 2002 and December 31, 2009 that sustained an unintentional fall-related injury all of whom required urgent trauma care or met criteria for transfer to Level I - III trauma hospitals. The ICD-9-CM external cause of injury codes used in our study population included: E880-E886 and E888. From these codes, we created variables for fall level and fall mechanism/type. Fall level was classified as:

different level (E880-E884), same level (E885-E886), and other/unspecified (E888). Fall mechanism/type was classified as: stairs/steps (E880), ladder/scaffolding (E881), building/other structure (E882), hole/other opening (E883), other different level (E884; playground equipment-.0, cliff-.1, chair-.2, wheelchair-.3, bed-.4, other furniture-.5, commode-.6, other-.9/e.g., tree, haystack, embankment, stationary vehicle), slipping/tripping/stumbling (E885; nonmotorized scooters, roller skates, skateboard, skis, snowboard, and other slipping/tripping), collision/pushing/shoving by or with other person (E886; in sports and other/unspecified), and other/unspecified fall (E888; striking against sharp object due to falling, striking against other object due to falling, other fall, and unspecified fall).

Trends were analyzed by estimating the rate of injury per trauma hospital population. Age and gender patterns were examined by demographic, injury event, injury type, severity, and outcome characteristics and statistically evaluated for differences using Chi-square tests. Data analyses were performed using SAS 9.2 (SAS Institute, Inc., Cary, NC, USA).

# **RESULTS**

Over the eight year period, 31,627 patients (39.3% of total trauma admissions) were admitted to a trauma registry hospital due to a fall-related injury, of which 853 (2.7%) died. Of all trauma cases, the rate for falls increased nearly 30% from 35.5 to 46.1 during the study period (Figure 1). Falls are also increasing in the lowa death certificate data (41.9%) from 2002 to 2009 (Figure 2).

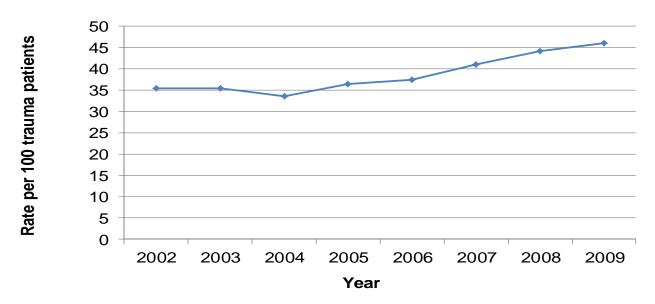


Figure 1. Unintentional fall-related injury rates (per 100 trauma patients) by year (STR Data).

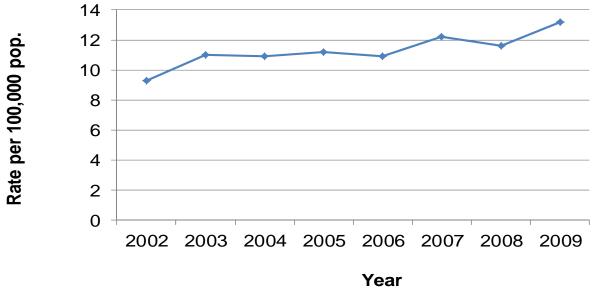


Figure 2. Unintentional fall-related injury death rates (per 100,000 population) by year (lowa Death Data).

Nearly 50% of females and 21% of males sustaining a fall injury were aged 75 and older (Figure 3). From the male to female ratio, males less than age 55 were more likely to sustain a fall injury than females; and for those age 55 and older, females had more fall injuries than males (p<0.0001).

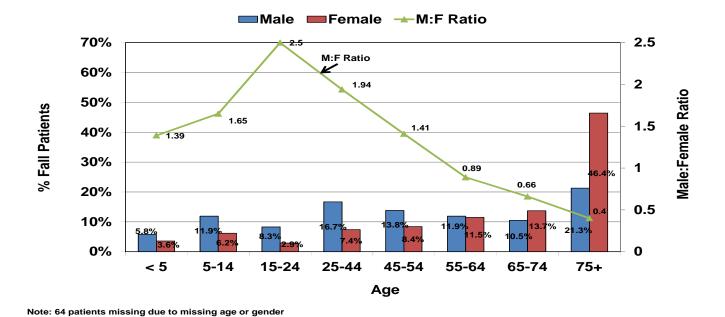


Figure 3. Percent (based on gender) of patients with fall-related injuries and the male to female ratio across age groups.

Fall level

Injury rates were higher for different level falls than same level falls in males yet decreased by 21% during the study period (Figure 4). While in females same level falls resulted in higher injury rates than different level falls yet were fairly steady across years except in 2006 where the rate decreased by 20%, but is on an upward trend again.

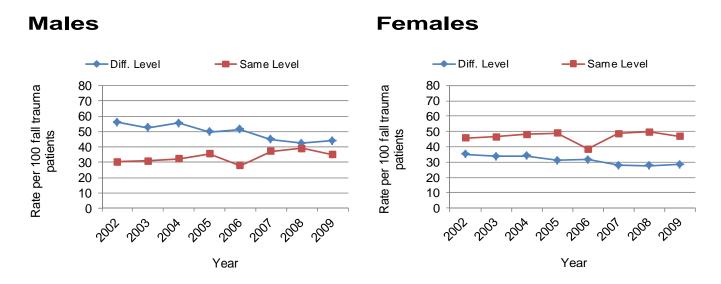


Figure 4. Unintentional fall-related injury rates (rate per 100 fall trauma patients) for fall level by year (stratified by gender).

When we examined fall level by age for each gender, different level falls were more common than falls from the same level in males less than age 75 (Figure 5; p<0.0001). In females age 15 and over, same level falls were the dominant fall level (p<0.0001).

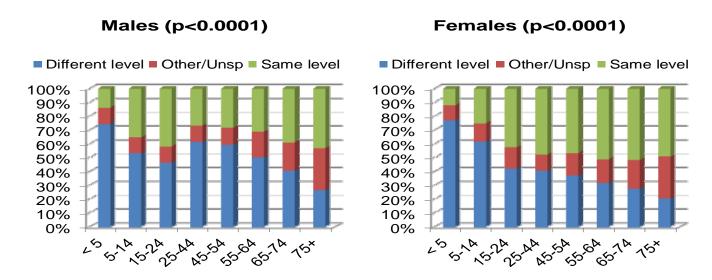


Figure 5. Fall level by age stratified by gender.

The rate of different level falls by year were highest in those less than age 15 followed by patients aged 55 and over (males and females) and increased in those under 15 (males) and in both men and women aged 55 and over in 2009 (Figures 6a &6b). Same level fall rates by year were highest in men and women aged 55 and over.

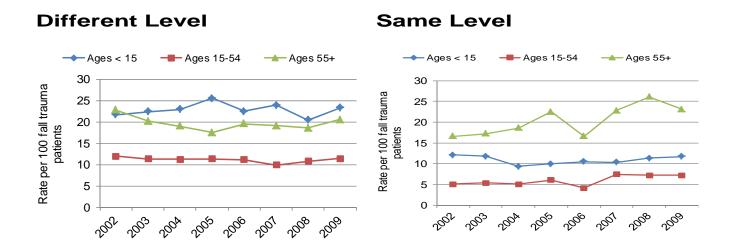


Figure 6a. Fall level by age (Males).

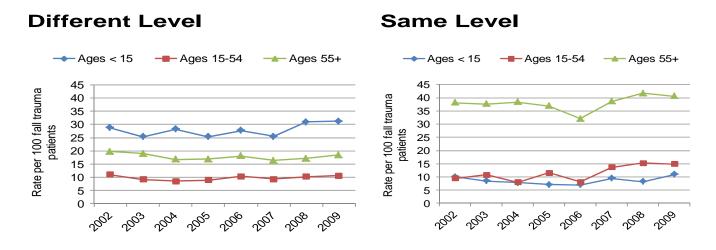


Figure 6b. Fall level by age (Females).

# Fall type/mechanism

Males less than age 15 were more likely to fall from a variety of different level falls (especially other and playground equipment); those aged 15-64 fell more often due to slipping/tripping, other types of different level falls, and ladders/scaffolding; and patients aged 65 and older were more likely to fall due to slipping/tripping (Table 1;

p<0.0001). Females less than age 15 were more likely to fall from other different level falls (in particular, playground equipment and other) as shown in males of that age range and those aged 15 and over fell more often due to slipping/tripping followed by stairs/steps (Table 2; p<0.0001).

	Age								
	< 5	5-14	15-24	25-44	45-54	55-64	65-74	75+	
	n (%)	Total							
Fall level/type									
Different level									
Stairs/Steps (E880)	106 (12.6)	50 (2.9)	93 (7.7)	259 (10.6)	232 (11.5)	193 (11.1)	194 (12.7)	370 (11.9)	1497
Ladder/Scaffolding (E881)	10 (1.2)	17 (1.0)	63 (5.2)	405 (16.6)	395 (19.6)	319 (18.3)	218 (14.2)	119 (3.8)	1546
Bldg/Other Structure (E882)	56 (6.7)	36 (2.1)	146 (12.1)	295 (12.1)	179 (8.9)	94 (5.4)	39 (2.6)	23 (0.7)	868
Hole/Other Open (E883)	3 (0.4)	9 (0.5)	22 (1.8)	49 (2.0)	19 (0.9)	6 (0.4)	4 (0.3)	3 (0.1)	115
Other different level (E884)	449 (53.5)	806 (46.4)	233 (19.3)	486 (19.9)	363 (18.0)	254 (14.6)	164 (10.7)	307 (9.9)	3062
Playground equip. (.0)	119 (14.2)	435 (25.1)	24 (2.0)	33 (1.4)	13 (0.6)	12 (0.7)	2 (0.1)	9 (0.3)	647
Chair (.2)	52 (6.2)	13 (0.7)	2 (0.2)	14 (0.6)	23 (1.1)	20 (1.2)	19 (1.2)	54 (1.7)	197
Bed (.4)	68 (8.1)	29 (1.7)	11 (0.9)	13 (0.5)	12 (0.6)	10 (0.6)	18 (1.2)	96 (3.1)	257
Other (.1, .3, .5, .6, .9)*	210 (25.0)	329 (19.0)	196 (16.2)	426 (17.5)	315 (15.6)	212 (12.2)	125 (8.2)	148 (4.8)	1961
Same level									
Slip/Trip (E885)	106 (12.6)	462 (26.6)	350 (29.0)	599 (24.6)	555 (27.6)	543 (31.2)	590 (33.5)	1343 (43.2)	4548
Collide/push/shove (E886)	12 (1.4)	154 (8.9)	158 (13.1)	58 (2.4)	16 (0.8)	6 (0.4)	7 (0.5)	7 (0.2)	418
Other/Unspecified (E888)	98 (11.7)	202 (11.6)	143 (11.8)	286 (11.7)	255 (12.7)	324 (18.6)	316 (20.6)	939 (30.2)	2563
Total	840	1736	1208	2437	2014	1739	1532	3111	14617

<sup>\*</sup> Included in 'Other' falls from a different level are falls from a cliff, wheel chair, other furniture, commode, as well as other types, for example, falls from an embankment, haystack, stationary vehicle, tree, etc.

Table 1. Fall type/mechanism by age (Males; p<0.0001).

	Age								
	< 5	5-14	15-24	25-44	45-54	55-64	65-74	75+	
	n (%)	n (%)	Total						
Fall level/type									
Different level									
Stairs/Steps (E880)	90 (14.9)	48 (4.6)	79 (16.4)	263 (21.0)	290 (20.3)	378 (19.3)	369 (15.9)	813 (10.3)	2330
Ladder/Scaffolding (E881)	6 (1.0)	6 (0.6)	9 (1.9)	49 (3.9)	67 (4.7)	73 (3.7)	64 (2.8)	54 (0.7)	328
Bldg/Other Structure (E882)	26 (4.3)	25 (2.4)	23 (4.8)	41 (3.3)	8 (0.6)	16 (0.8)	4 (0.2)	9 (0.1)	152
Hole/Other Open (E883)	3 (0.5)	5 (0.5)	4 (0.8)	15 (1.2)	10 (0.7)	3 (0.2)	5 (0.2)	2 (0.03)	47
Other different level (E884)	338 (56.1)	562 (53.5)	89 (18.4)	139 (11.1)	148 (10.4)	149 (7.6)	186 (8.0)	691 (8.8)	2302
Playground equip. (.0)	92 (15.3)	373 (35.5)	8 (1.7)	12 (1.0)	8 (0.6)	5 (0.3)	6 (0.3)	25 (0.3)	529
Chair (.2)	33 (5.5)	9 (0.9)	3 (0.6)	13 (1.0)	25 (1.8)	25 (1.3)	38 (1.6)	154 (2.0)	300
Bed (.4)	43 (7.1)	26 (2.5)	4 (0.8)	10 (0.8)	5 (0.4)	10 (0.5)	32 (1.4)	230 (2.9)	360
Other (.1, .3, .5, .6, .9)*	170 (28.2)	154 (14.7)	74 (15.3)	104 (8.3)	110 (7.7)	109 (5.6)	110 (4.8)	282 (3.6)	1113
Same level									
Slip/Trip (E885)	72 (11.9)	232 (22.1)	175 (36.2)	578 (46.1)	662 (46.4)	997 (51.0)	1201 (51.9)	3859 (49.1)	7776
Collide/push/shove (E886)	3 (0.5)	34 (3.2)	32 (6.6)	21 (1.7)	6 (0.4)	8 (0.4)	4 (0.2)	27 (0.3)	135
Other/Unspecified (E888)	65 (10.8)	139 (13.2)	72 (14.9)	147 (11.7)	236 (16.5)	330 (16.9)	482 (20.8)	2405 (30.6)	3876
Total	603	1051	483	1253	1427	1954	2315	7860	16946

<sup>\*</sup> Included in 'Other' falls from a different level are falls from a cliff, wheel chair, other furniture, commode, as well as other types, for example, falls from an embankment, haystack, stationary vehicle, tree, etc.

Table 2. Fall type/mechanism by age (Females; p<0.0001).

# Place of occurrence

In males, across age groups, the largest proportion of falls occurred in the home with the exception of the 15-24 age group where they were more likely to be injured in a recreational setting (24.8%) followed very closely by home (24.5%). A large proportion of males aged 5-14 were also injured in a recreational setting (31.2%).

For females, the highest proportion of falls also occurred in the home across all age groups (64.5%). In those aged 5-14 and 15-24, the 2<sup>nd</sup> leading place of injury occurred in a recreational setting (31.5% and 20.3%, respectively).

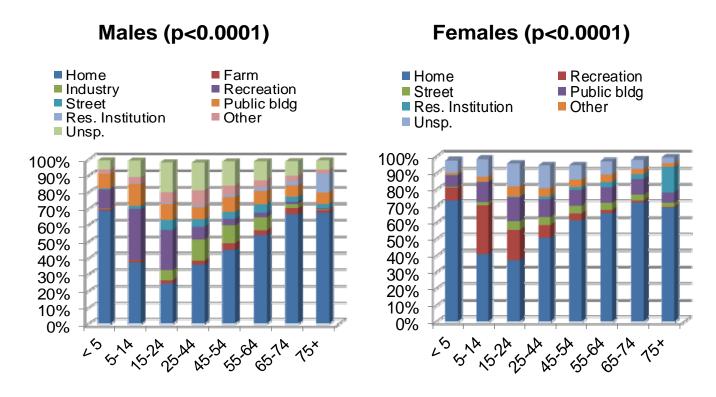


Figure 7. Place of occurrence by age stratified by gender (includes cases with place of occurrence totals > 2% of overall total).

Work-related falls in males aged 15 and over

As observed for fall levels overall, work-related falls in males showed the same trend; those less than age 75 were more likely to fall from different levels while those aged 75 and older fell more often from the same level (Table 3; p<0.0001). Non-work-related falls in males showed similar results, except in those aged 15-24 and 65+ were more likely to fall from the same level, yet were close in proportion (p<0.0001).

	Age							
	15-24	25-44	45-54	55-64	65-74	75+		
	n (%)	Total						
Work-related (p<0.0001)*								
Fall level/type								
Different level								
Stairs/Steps (E880)	2 (1.2)	8 (1.2)	13 (2.8)	8 (2.9)	5 (4.6)	2 (5.9)	38	
Ladder/Scaffolding (E881)	44 (27.3)	212 (31.7)	149 (31.7)	78 (28.1)	22 (20.4)	4 (11.8)	509	
Bldg/Other Structure (E882)	48 (29.8)	130 (19.5)	66 (14.0)	33 (11.9)	10 (9.3)	1 (2.9)	288	
Hole/Other Open (E883)	3 (1.9)	9 (1.4)	10 (2.1)	3 (1.1)	1 (0.9)	1 (2.9)	27	
Other different level (E884) <sup>†</sup>	38 (23.6)	170 (25.5)	110 (23.4)	79 (28.4)	32 (29.6)	8 (23.5)	437	
Same level								
Slip/Trip (E885)	13 (8.1)	94 (14.1)	92 (19.6)	55 (19.8)	29 (26.9)	16 (47.1)	299	
Collide/push/shove (E886)	1 (0.6)	2 (0.3)	3 (0.6)	2 (0.7)	0 (0.0)	0 (0.0)	8	
Other/Unspecified (E888)	12 (7.5)	43 (6.4)	27 (5.7)	20 (7.2)	9 (8.3)	2 (5.9)	113	
Total	161	668	470	278	108	34	1719	
Nonwork-related (p<0.0001)								
Fall level/type								
Different level								
Stairs/Steps (E880)	85 (8.6)	242 (14.3)	214 (14.4)	180 (12.7)	183 (13.6)	350 (11.9)	1254	
Ladder/Scaffolding (E881)	17 (1.7)	174 (10.3)	228 (15.3)	233 (16.5)	180 (13.4)	107 (3.6)	939	
Bldg/Other Structure (E882)	93 (9.4)	156 (9.2)	104 (7.0)	58 (4.1)	26 (1.9)	22 (0.8)	459	
Hole/Other Open (E883)	18 (1.8)	40 (2.4)	8 (0.5)	3 (0.2)	2 (0.2)	2 (0.1)	73	
Other different level (E884) <sup>†</sup>	185 (18.7)	302 (17.8)	248 (16.7)	171 (12.1)	125 (9.3)	289 (9.8)	1320	
Same level								
Slip/Trip (E885)	324 (32.8)	490 (28.9)	453 (30.5)	473 (33.4)	534 (39.8)	1256 (42.8)	3530	
Collide/push/shove (E886)	143 (14.5)	55 (3.2)	13 (0.9)	4 (0.3)	7 (0.5)	6 (0.2)	228	
Other/Unspecified (E888)	124 (12.5)	237 (14.0)	219 (14.7)	293 (20.7)	285 (21.2)	904 (30.8)	2062	
Total	989	1696	1487	1415	1342	2936	9865	

<sup>\* 431</sup> males were coded as 'Unknown' or 'NA' for work-related.

Table 3. Fall type/mechanism by age and work-relatedness (males aged 15 and over).

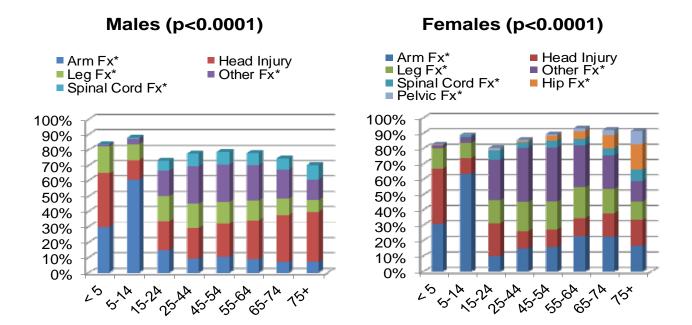
Work-Related Fall type/mechanism in males aged 15 and over

For work-related falls in males aged 15-74 years, they were more likely to fall from other different level falls and ladders/scaffolding (Table 3; p<0.0001). Males aged 75 and over fell more often from slipping/tripping. Nonwork-related falls resulted in a different pattern of fall types than work-related falls. Across all age groups, slipping/tripping falls were the most prominent fall type (p<0.0001). Note the larger numbers of non-work-related different level falls in particular, especially in males aged 25 and older, especially falls from buildings/other structures and ladders/scaffolding. This may be indicative of home improvement projects or home repair/maintenance work.

# Primary nature of injury

Head injuries were the most common injury in those under age 5 years (males and females). Head injuries increased in proportion with age in males for ages 15 and older (Figure 8; p<0.0001).

<sup>†</sup> Included in 'Other' falls from a different level are falls from a cliff, wheel chair, other furniture, commode, as well as other types, for example, falls from an embankment, haystack, stationary vehicle, tree, etc.



#### \* = Fx denotes fracture

Figure 8. Primary nature of injury by age stratified by gender.

# Injury severity

The severity of injury due to falls was measured by the Injury Severity Score (ISS). In males there was an increase in more severe injuries (ISS 16+) with age (Figure 9; p<0.0001). However, the least severe injuries (ISS 1-8) were most common across age groups. In females, the least severe injuries comprised the highest proportion of injuries across age groups (p<0.0001).

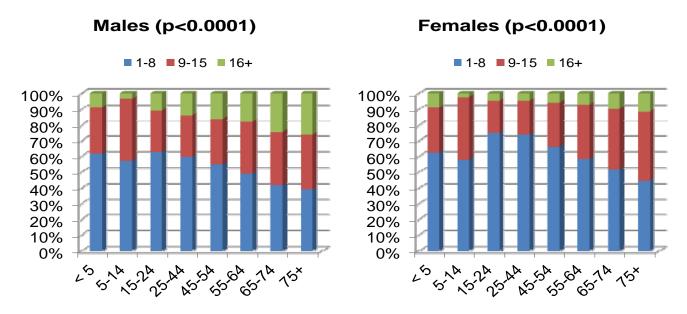
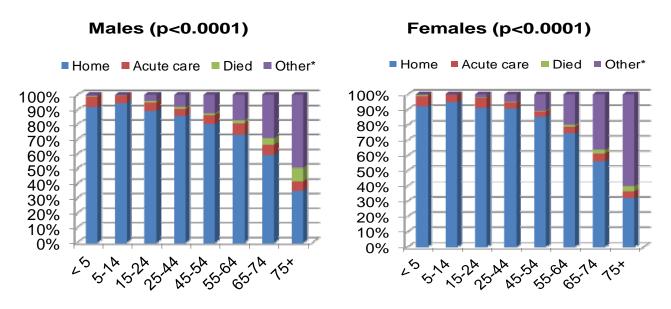


Figure 9. Injury severity score (ISS) by age stratified by gender.

# Clinical Outcome

Nearly 63% of patients were discharged to home. In males, as age increased there was an increase in the proportion of patients needing other care (e.g., rehab, long-term care, skilled nursing) or died, particularly those aged 65 and older (Figure 10; p<0.0001). The proportion of patients in need of further acute care remained fairly consistent across age groups. For females, a similar pattern as with males occurred in patients needing other types of care or died yet the proportion of those needing other care was higher and in those that died was lower than in males (p<0.0001).



<sup>\* &#</sup>x27;Other' is comprised of rehab, long-term care, and skilled nursing

Figure 10. Discharge disposition by age stratified by gender.

For males and females, median LOS increased with age ranging from 1-4 days (both genders p<0.0001). Nearly 11% (n=3,556) of patients were hospitalized greater than 7 days. Males and females had nearly equal proportions of patients hospitalized greater than 7 days (12.1%, 10.9%, respectively). Of those that were aged 65 and over, 15.9% were hospitalized for more than 7 days (Males=20.0%; Females=14.1%).

As with hospital charges by age alone, the median charges for males increased with age (\$4,436 - \$14,208). For females, the median charges increased with age except at ages 75 and older they decreased slightly (\$4,555 - \$12,830).

# **DISCUSSION**

Unintentional fall-related injuries and deaths are on the rise in Iowa. Referrals for care by trauma hospitals are increasing. It has become increasingly apparent that we need to better understand how the etiology of falls differs by gender across the lifespan. Our findings indicate differences by level and mechanism of fall. A better understanding of the etiology of unintentional falls will help us to develop better prevention strategies in an effort to reduce the burden of fall-related injuries and deaths.

Different level fall rates were highest in those less than age 15 followed by those aged 55 and over (both genders); the rates for those age groups and slightly so for ages 15-54 for males are on the rise again. This may likely continue to do so with increasingly more people undertaking home improvement projects and the general keeping up with routine maintenance around the home. We observed an increase in more severe injuries, especially in males. This also coincides with the head injured patients, in particular those less than age 5 and aged 65 and over, and the outcomes of long-term care and death increasing with age in patients aged 65 and over. Thus, with what we have observed from the data, recommendations and prevention strategies need to be focused on specific risks.

Environmental conditions such as weather, home design, and structural surfaces may warrant change in behaviors.

# **SUMMARY**

With what we have observed from the data, recommendations and prevention strategies need to be focused on specific risk factors. As we have shown, patterns of fall injuries presenting to trauma hospitals differ by age and gender, this is an opportunity to focus our prevention strategies on specific age and gender groups. We recommend the following:

• In toddlers/young children, falls from playground equipment were most common in both males and females, and as recommended by the CDC-funded National Program for Playground Safety: Improve adult supervision of children on playgrounds; educate the public about age-appropriate playground equipment; build playgrounds

- with surfaces—such as shredded rubber, wood chips, wood fiber, and sand—that reduce injuries related to falls; improve maintenance of equipment and surfacing.<sup>3</sup>
- For teenagers/young adults, males fell more often from slipping/tripping, other different levels, and ladders/scaffolding. A majority of these falls occurred at home, recreational settings, and industrial/occupational settings. Females also were more likely to fall from slipping/tripping and stairs/steps. Many occurred in the home and recreational settings. High risk recreational injuries highlight the need for further education and protective equipment. For occupational injuries, we need to continue to provide education through safety training and supervision.
- For the middle age range, males were more likely to fall from slipping/tripping, ladders/scaffolding, and other different levels. In females, slipping/tripping was the most common mechanism. Some of these falls were work-related (predominantly in males) yet a large majority occurred at home. Similar strategies for occupational falls need to be applied for home fall prevention (e.g., ladder use and stabilization). Environmental conditions such as weather, home design, and structural surfaces may warrant a change in behaviors.
- In the older age groups (both genders), same level falls was the most common fall level (predominantly from slipping/tripping), which again the majority of falls occurred in the home. Physical capabilities and risk factors need to be considered in the elderly population. Thus, prevention strategies aimed at changing the environment and fall-proofing the home (e.g., removing throw rugs, maintaining proper lighting, applying protective coverings/cushioning to corners of night stands, footboards on beds, coffee tables), evaluation of comorbidities (e.g., gait/balance disorders, dizziness/vertigo, visual disorders, hypotension, arthritis, osteoporosis, diabetes, other types of neurologic disorders), education on medications that may cause dizziness may assist in reducing fall-related injuries in the elderly, and offering physical activity programs to seniors geared at improving flexibility, strength, and balance. 4-13

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